Links between Nitrogen Induced Susceptibility to Rice blast and the components of Nitrogen Use Efficiency

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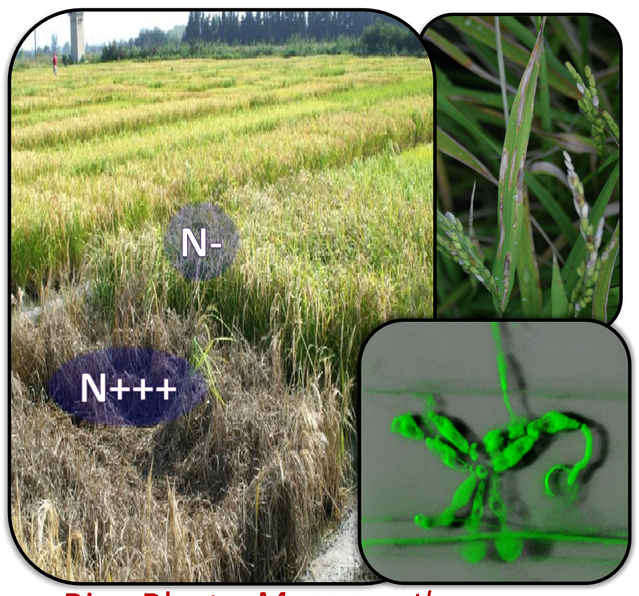
Nitrogen Induced Susceptibility ➔ NIS

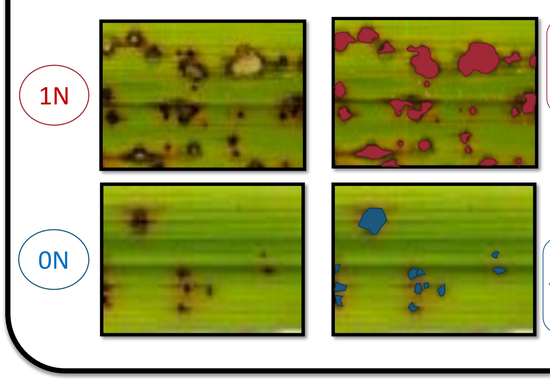


Rice Blast *Magnaporthe oryzae*

Excessive N fertilization increase **Rice Blast severity**[1]

NIS varies with the plant genotype[1]

Magnaporthe oryzae is **more aggressive** with an N excess, **over-passing plant defenses**[2]



$Nb\ lesion^{1N}/_{Leaf\ Area}$

$Nb\ lesion^{0N}/_{Leaf\ Area}$

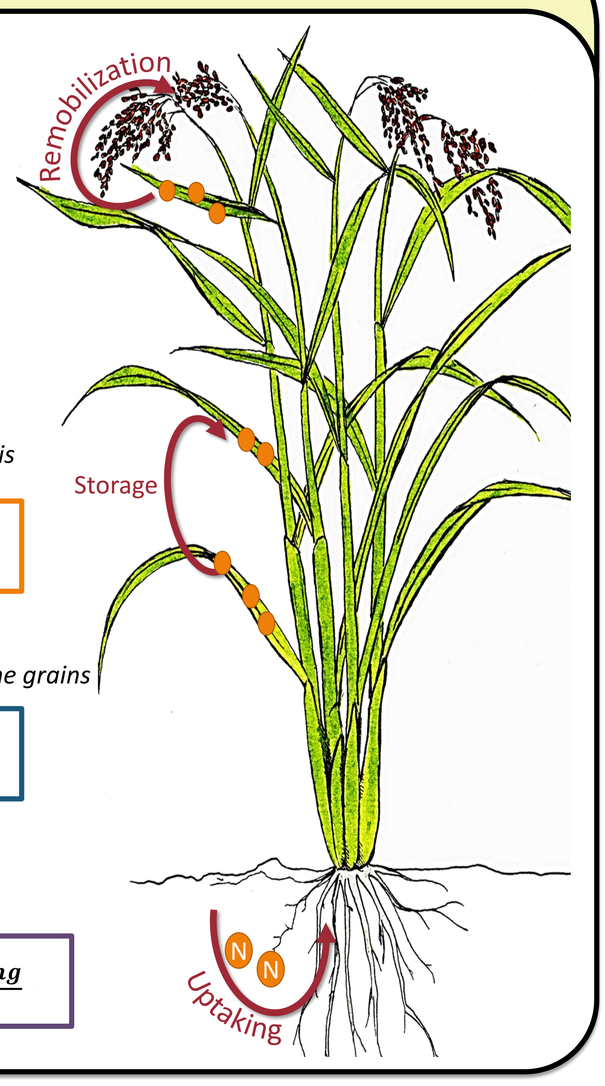
$$\frac{1N}{0N} = \text{NIS value}$$

Nitrogen Use Efficiency ➔ NUE

Dry matter per unit of N available from the soil, fertilizer included

NUE genetic diversity exists in Rice[4,5]

NUE can be broken down in three major **components**[3]**:**



➢ **Uptake efficiency pre anthesis**

ability to take the nitrogen from the soil before anthesis

$$Eff_{up\_pre} = \frac{N^{*}\ at\ flowering}{N\ available\ in\ soil}$$

➢ **Remobilization Efficiency**

ability to transfer nitrogen stored from the leaves to the grains

$$Eff_{remo} = \frac{N\ at\ flowering - N\ in\ grains}{N\ at\ flo}$$

➢ **Uptake efficiency pre anthesis**

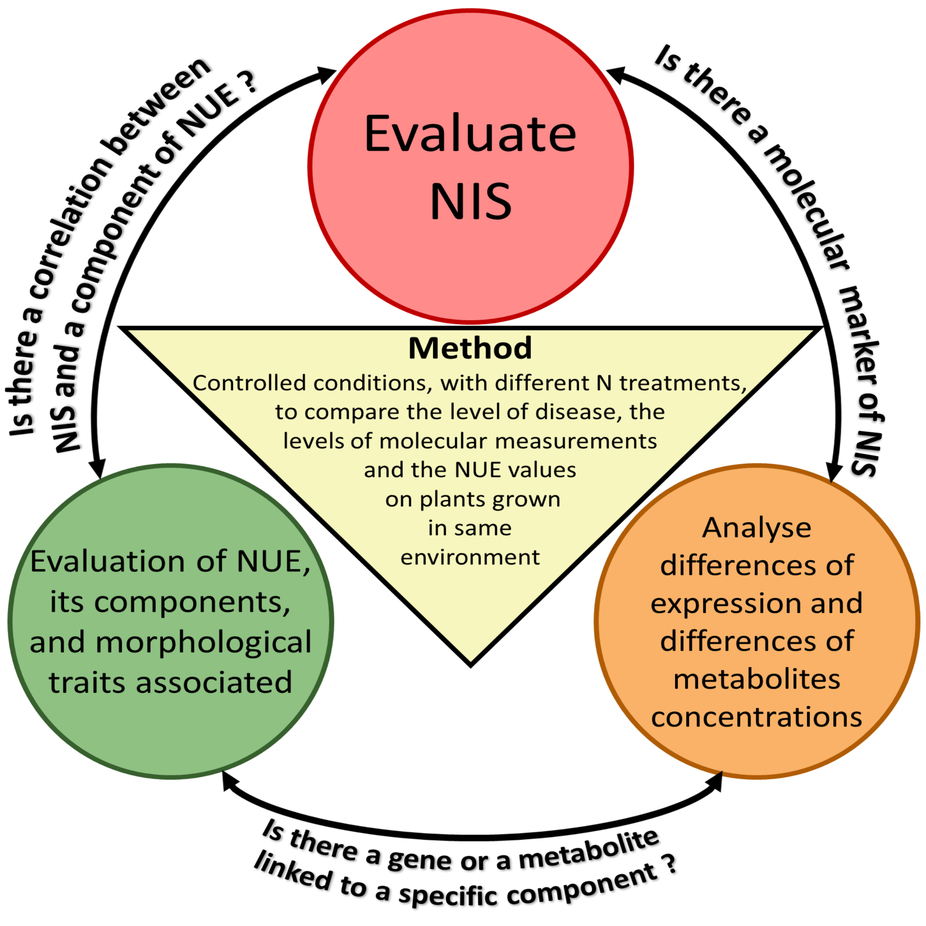
ability to take the nitrogen from the soil after anthesis

$$Eff_{up\_post} = \frac{N\ in\ at\ maturity - Nat\ flowering}{N\ available\ in\ soil}$$

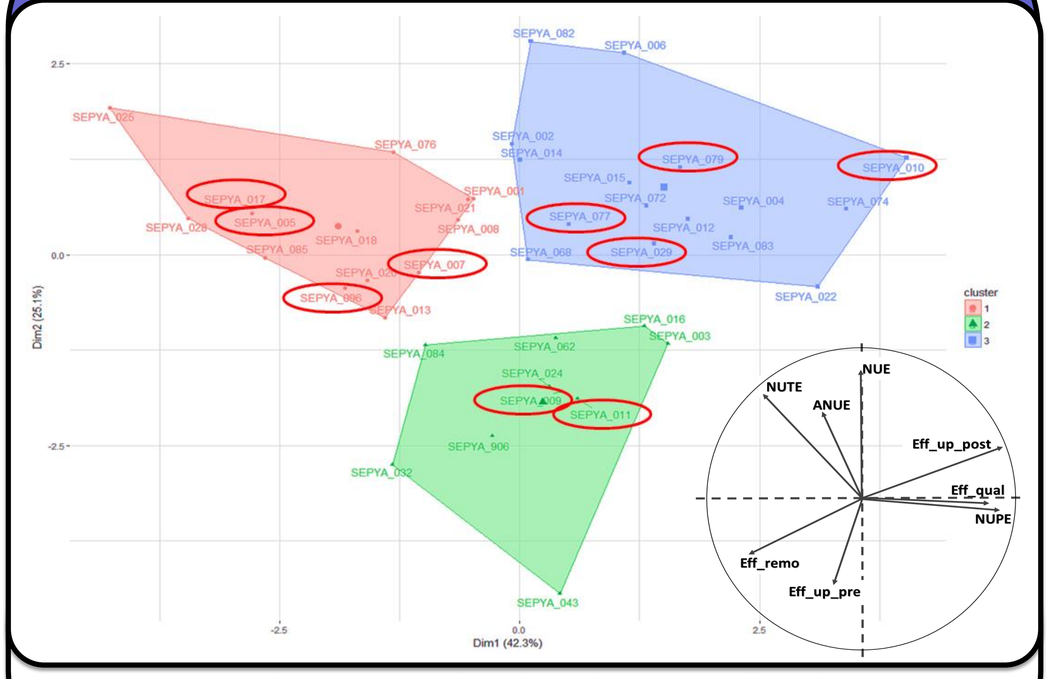
* N = quantity of nitrogen by dry biomass of aerial part in 1m²

Hypotheses :

- **NIS** could be correlated with a **NUE component**
- A particular **component** could trigger a **signal** causing a increase of the **aggressively of the blast fungus**
- This **signal** could be related with the nitrogen flows

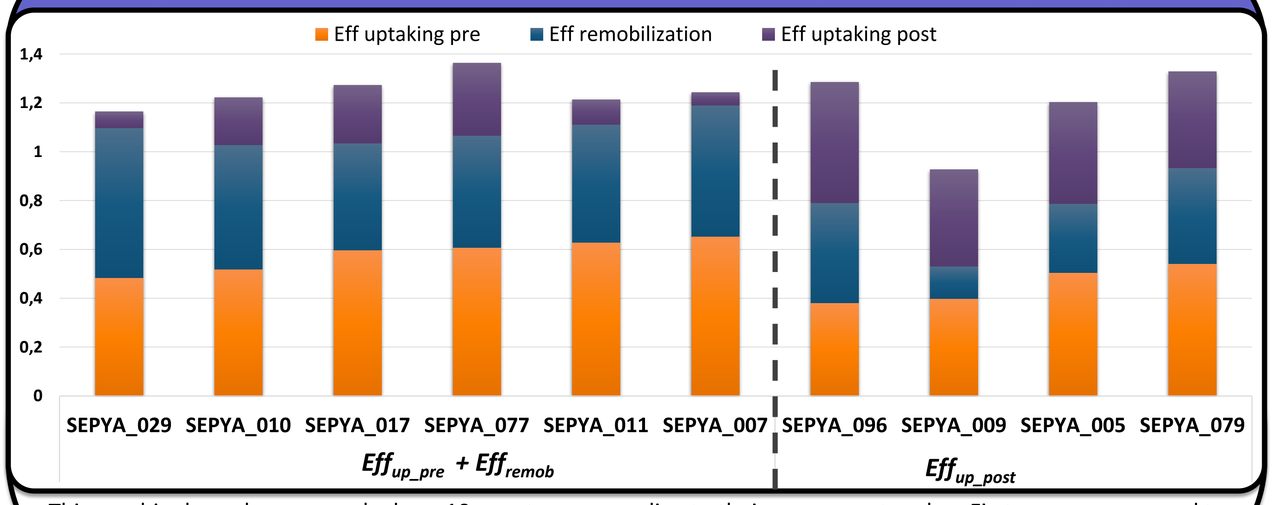


Clustering of the diversity of NUE components



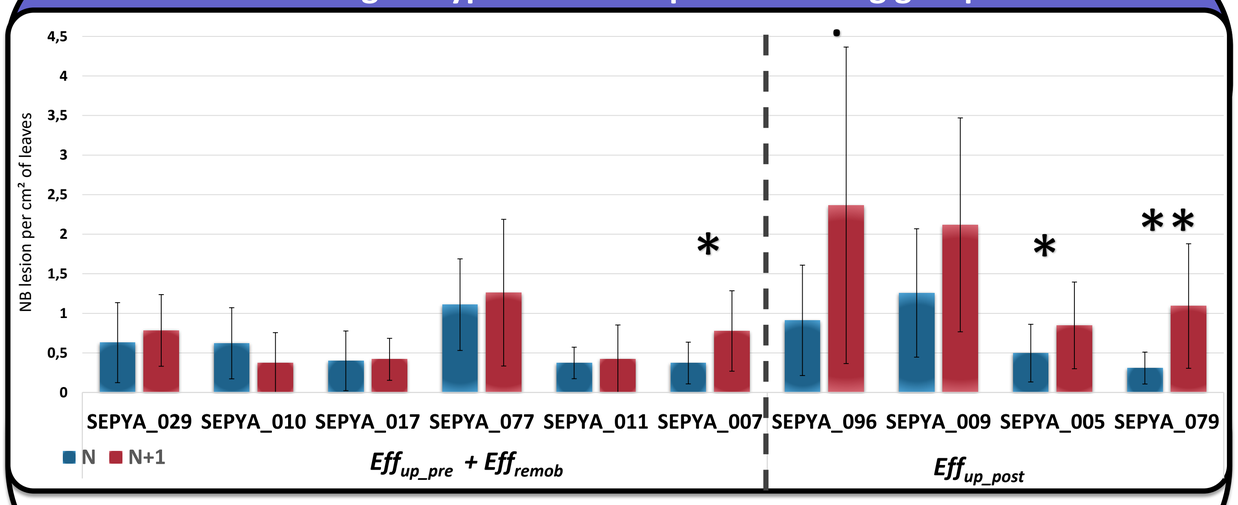
We measured NUE, NUTE (Nitrogen Utilization Efficiency), NUPE (Nitrogen Uptake Efficiency) Agronomic NUE, and NUE components of 50 genotypes from a population of *japonica* temperate. The PCA informs us the Eff_{remo} and the Eff_{up_pre} are correlated, and they are anti-correlated with Eff_{up_post} We clustered this genotypes from the PCA. This analysis confirms the diversity of way to use the nitrogen. 10 genotypes have been choice for in this cluster among to be tested in further experiments

Big differences exist between the use of Nitrogen in our 10 genotypes



This graphic shows how we ranked our 10 genotypes according to their components value. First group correspond to plants uptaking the nitrogen before flowering and remobilizing it, the other group doesn't remobilize so much but uptakes more after flowering,

More genotypes do NIS in post flowering group



Nb lesion per cm² of leaves difference between 2 N treatments. N : pots with no fertilizer shot; N+1 : pots with a fertilizer shot (100ml 40mg/L of $NO3^-$ and 40mg/L of $NH4^+$). P-value calculated by an Anova.

Conclusion and outlooks

- There is a huge phenotypical diverstiy of nitrogen using in our *jap.* temperate population.
- It appears ***NIS*** and Eff_{up_post} could be linked. The real correlation remains to be established
- Samples have been collected in different nitrogen treatments, biochemical and transcriptomic analysis are ongoing. A marker linking NIS and Eff_{up_post} could be found.
- We will test blast behavior *in vitro* face to several metabolites according to that results

References:

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2. Huang, H., Nguyen Thi Thu, T., He, X., Gravot, A., Bernillon, S., Ballini, E., and Morel, J.-B. (2017). Increase of Fungal Pathogenicity and Role of Plant Glutamine in Nitrogen-Induced Susceptibility (NIS) To Rice Blast. Front. Plant Sci. 8.
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